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THE GENESIS OF GOLD IN MINERAL VEINS AND PLACERS.

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IN our limited sphere of observation we can know but little of the internal structure of the earth. Assuming it once to have been a molten liquid mass, it is natural to conclude that the denser constituents would be grouped nearest the center, and as the earth cooled, and as rifts were made by contraction of the solid crust down to the liquid interior, the molten rock extruded through these cracks would contain more of the heavy metals. Were the fissure deep enough the outflow might be metals like gold or platinum, or even heavier substances, unknown on the earth's surface.

The hypothesis of a liquid interior has little to support it, and whatever may be the temperature it is certain that the earth's interior is a mass of great rigidity, and we can form little conjecture how its elements are combined and grouped.

The fact of rifts in the crust may be admitted, and that these were ways of exit of a molten magma which filled the crevices and flowed out as it does to-day in volcanoes.

But these fissures are filled not only with igneous rock but with materials crystallized out of solutions. One of the commonest of these crystallized substances is quartz, either alone or intermixed with oxides, sulfides, etc., of various metals, or with the metals uncombined, as gold and silver. The solvent which carried this silica and these metals is doubtless water, which comes nearest of any liquid to being the universal solvent. In explaining earth problems we must always keep in mind the ever-present water, which, first enveloping the earth as a vapor, must have been continually exerting its solvent powers on whatever was beneath and around it. Not only does it act on surfaces but it penetrates the interiors of substances, and its energy is increased by the gases, such as chlorine, with which it may be saturated, and by the high temperature, at which it must always have existed.

If we start now with the situation when the igneous rocks and crystallizations fill the fissures and outcrop on the surface of the earth, we find the water acting in another role. It is now to grind down the surface by glacial action, to plow out the valleys by erosion, and to sift the fine from the coarse, the heavy from the light, till the deposits are brought to their present condition. The gold

deposits of Cape Nome, of the Rand and of innumerable placers are the results of these actions of the waters in their grinding, carrying and sifting capacity.

As already intimated, the gold found in quartz fissure veins may have been deposited with the silica from the water.

We may inquire, then, whether the seas, which cover a large part of the earth's surface, still carry gold in solution.

On authority of the English chemist, Liversidge, a ton of sea-water contains on an average one grain of gold. If this be true, we can calculate the amount of gold in the waters of the sea. Chamberlain and Salisbury, in their recent text-book on geology, estimate the quantity of sea-water at 1300 quadrillion tons. This, then, is the number of grains of gold spread abroad in the sea. The number of grains in a cubic foot of gold is, approximately, 8,312,500. The total number of grains, divided by this, gives 15,639,218,045, the number of cubic feet of gold dissolved in the waters of the sea. This more than equals a cube of gold 2500 feet on each edge.

This universal distribution of gold in water is accompanied by its almost equally general occurrence in mineral deposits, and perhaps accounts for the latter fact. In studying the physical aspects of the earth, we are apt to look upon it as a completed structure, and we think of the great changes revealed to us in geology as having no counterpart in the present time. A moment's reflection will convince us that earth changes are yet going on by which the structure may be altered as much as it has been in past eons.

As to the possibility of gold veins and placers being even now in the process of formation, we have some evidence to support such a hypothesis. In the University of California Bulletin, vol. 4, No. 10, John A. Reid discusses the origin and genesis of the Comstock lode. He treats of the geological formation and development of the Comstock lode mines, and comes to certain conclusions as to the part water has played in the "bonanzas" of these rich veins. The primitive vein of gold-bearing mineral has had the gold leached out of it, as it were, to be redeposited in secondary veins, which become thereby extremely rich in gold, and this investigator thinks the process may be still going on in the deeper levels of the mine. He finds by analysis of the vadose water of the mine a percentage of gold greater than sea-water contains, and the deposit of the metal in newly opened fissures is easily seen possible.

What is going on in the Comstock mine may have its counterpart in other veins, known or undiscovered, and suggests the

thought that in future ages gold veins may be worked where the gold at this present time is not deposited.

In this paper the inquiry has been limited to gold, but it is easily seen that similar conclusions could be reached respecting other metals, and that water has had an important part in determining the location and condition of ore deposits. We can find near the surface of the earth all the material needed to supply the mineral veins, and it is unnecessary to suppose that the heavy metals must have come from great depths.